IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

SKYLINE SOFTWARE SYSTEMS, INC., Plaintiff,	)	
v.	)	CIVIL ACTION NO. 04-1129-DPW
KEYHOLE, INC. and GOOGLE, INC., Defendants.	)	

DECLARATION OF TERRY KEATING, PH.D.

I, Terry Keating, on oath depose and state that:

1. I am the President of Lucerne International, of 181 Stoneway Trail, Madison, AL 35758, a company based on photogrammety computer mapping and AIS (which is) software and services.

2. I have been retained by counsel for Skyline Software Systems, Inc. ("Skyline"), at the rate of $250 per hour, for consultation in connection with the patent infringement litigation between Skyline and the Defendants Keyhole, Inc. and Google, Inc. concerning U.S. Patent No. 6,496,189 (the "'189 Patent"), which is attached as Exhibit 7 to the Declaration of H. Joseph Hameline, Esq. ("Hameline Decl.") submitted in support of Skyline's Motion for a Preliminary Injunction.

3. As reflected in my curriculum vitae, which is attached hereto as Exhibit A to my Declaration, I have worked in the mapping industry for over thirty years, with over fifteen years of experience in the three-dimensional (3D) mapping, Earth imaging and GIS software fields. I received my Bachelors of Science in civil and environmental engineering from the University of Wisconsin-Madison in 1970. I thereafter obtained my

Masters in Science from the University of Wisconsin-Madison in remote sensing in 1971. In 1975, I obtained a Ph.D. in photogrammetry, remote sensing, and surveying from the University of Wisconsin-Madison in 1975. I have been a registered land surveyor and a professional engineer since 1976. I have been a certified photogrammetrist since 1998. In addition, I have held several leading positions in national surveying and photogrammetry associations. For example, I served as the Director of the Management Association for Private Photogrammetric Surveyors (2000-02), and President of the American Society for Photogrammetry and Remote Sensing (2002-03) and of the Mapping Sciences Committee of the National Academy of Science (1995-97). In addition, I have authored and presented numerous articles on the subject of mapping, photogrammetry and Earth imaging solutions.

4. The focus of my work over the past ten to fifteen years has been on Earth imaging solutions, including systems, software and related services used for the production, visualization, and geospatial information and management of maps produced using space imagery, aerial photography, and other remote sensors. Over the course of the past ten years, I have served as a consultant and project manager on large projects involving mapping, surveying, and information technologies. I founded three companies, Kork Systems, Digital Mapping Associates, and Lucerne International, all of which focused on photogrammetry, computer mapping and/or GIS software and services. In addition to my work with these three businesses, from 2002 to 05, I have been employed by Intergraph Corporation, where I served as a Division Vice President and Chairman of Z/I Imaging, a wholly owned subsidiary.

5. Based on my extensive work and experience in the field over the past thirty years, I am very familiar with the technology discussed in the '189 Patent. I have reviewed publicly available records and documents about the '189 Patent, as well as the products accused of infringement in this case, collectively called "Google Earth." Based on these documents and my knowledge of the technology, I understanding of the functionality and technology involved in the Google Earth products.

6. Prior to the invention claimed in the '189 Patent, it was difficult to provide substantial amounts of 3D data of terrain images over the Internet or other communication devices, as the amount of data required to render such images is quite large. This is particularly true of 3D data required to simulate travel over realistic terrain and to zoom into higher resolutions images of terrain areas. Providing such data on demand or in real-time simply was not practicable prior to Skyline's invention given the voluminous data required for computer rendering of 3D images, the limitations on the speed and amount of information that could be streamed over the Internet and the methods of downloading such information from a server to a client that existed at that time.

7. The invention described in the '189 Patent addressed these problems. In general, the Patent relates to computerized rendering and visualization of 3D terrain images and related data associated with the images. Skyline's invention provided a means by which to efficiently stream data describing 3D terrain from a server to a client over a network, such as the Internet, and rendering a more seamless view of the 3D terrain to a user of the client machine. In the '189 Patent, the data representing 3D terrain is divided into what the Patent calls "data blocks." Data blocks may include, for

example, topographical data such as elevation or altitude data, and/or image data from aerial or satellite photography. Data blocks may also include additional data objects, such as labels, lines or 3D objects (including map symbols, roads, buildings, and proposed structures) that are associated with particular locations in or as part of the terrain.

8. In the Skyline invention, data is organized hierarchically based on the different resolution levels by dividing the data into a grid or blocks. For each block of a lower resolution, there are typically four blocks of a higher resolution level that cover the same terrain area, but contain a significantly greater amount of detail for that area (and four blocks for each block in that set of four blocks, etc.). The blocks with the highest resolution level have the most amount of detail per unit area. The blocks are referenced using coordinates, such as x, y, (longitude, latitude), and also height and/or resolution level.

9. This hierarchical structure can be described as follows: When the user zooms in to view a specific area in the terrain, the server provides the client computer with data blocks for that terrain area. If the user had previously downloaded data blocks for that area, they may be stored in the client's local memory and may be used to display the requested terrain. Use of the stored data in the local memory allows the data blocks to be accessed quickly. If the requested data block is not available in local memory at the desired resolution, a block of the requested area with a relatively low level of resolution is downloaded. This data block may contain a lesser amount of detail than sought by the user, however, it can be downloaded and displayed quickly, thereby eliminating any time period when the user is forced to view a frozen or blank computer screen. Resolution

blocks with successively higher resolution levels are then downloaded to sharpen the image rendered at the client, until the block matching the requested location and indicated resolution has been downloaded. As the user indicates higher resolution images by, for example, moving from a view of a particular city to a neighborhood, higher resolution blocks are downloaded to the client and the renderer on the client machine displays an image with increasing resolution.

10. Based on my review of the publicly available information and my extensive experience in the mapping and GIS software fields, Defendants' Google Earth products perform in the same manner as described in the '189 Patent. The Google Earth products provide 3D graphics, mapping and visualization of global terrain locations, via the Internet.

11. For example, as required by Claim 1 of the '189 Patent, the Google Earth products use data blocks describing 3D terrain, such as the Earth's surface, to a renderer on the client computer in a hierarchical fashion, whereby the data blocks contain several different resolution levels. Given my experience in the relevant field and my reading of the '189 Patent, I understand the term "data block" to mean a quantity, set or amount of information or data representing a portion of the terrain and the term "terrain" to mean the physical features of an area, object or material.

12. The publicly available Google literature reflects that the Google Earth products include "Imagery and 3D data depicting the entire earth - Terabytes of aerial and satellite imagery depict cities around the world in high-resolution detail." Hameline Decl., Exh. 16. Defendants' website further provides that: "With [Google Earth], your computer becomes a window to anywhere on the planet, accessing Terabytes of aerial

and satellite imagery, elevation data, street-level data, business listings, and more" Hameline Decl., Exh. 13 at 11; Exh. 17. In other words, the Google Earth products depict data representing a portion of 3D physical features of the terrain, *i.e.*, Earth. I understand that Defendants argue that "terrain" should be defined as "the surface features of an area of land; topography." The publicly available literature about the Google Earth products reveal that they include, at a minimum, the 3D surface features of an area of land, or topography, as well as the surface features of other areas, objects and materials. Hameline Decl., Exhs. 10, 13, 16, 17.

13. As also required by Claim 1 of the '189 Patent, the data blocks used by the Google Earth products are arranged in a "hierarchical structure," that is, different data blocks contain different levels of resolution. Hameline Decl., Exh. 13 at 109. Based on my reading of the '189 Patent, I understand the phrase "hierarchical structure" to mean data blocks arranged in multiple levels of resolution, with each level of the structure containing blocks of a different resolution level. The Google Earth products use data blocks arranged in a hierarchical structure in this same way. Based on my use of the Google Earth product that is freely available by simply downloading the software from the website www.earth.google.com, the terrain images displayed (or rendered) on the client computer sharpen up (or reach a higher resolution level) after they are initially requested. For example, if a user of the Google Earth product zooms into a particular area, such as a city block, there is a slight delay in viewing the high resolution imagery of that area. Hameline Decl., Exh. 10. During the brief period of delay, the user is able to observe a grid-like image comprised of blocks of data. As the "Streaming status bar" indicates that additional data is being downloaded to the client, each block contained in

the grid (which initially appears blurry) begins to sharpen. When the "Streaming status bar" indicates that the necessary additional data blocks have been downloaded, the blocks appear at the higher level of resolution requested or indicated by the user. Hameline Decl., Exh. 10. Even under Defendants' interpretation of hierarchical structure to be organized into multiple levels of resolution, whereby each level contains data blocks at the same resolution, and each viewable successive level contains data blocks of a higher resolution than those in the preceding level (Hameline Decl., Exh. 15 at 19), the accused products would have the claimed hierarchical structure. Hameline Decl., Exhs. 10, 13.

14. As described in the Google Earth literature, "the Streaming status bar indicates when the Keyhole client is actively retrieving information streamed from the Keyhole Server database. The bar indicates the percentage of information retrieved. You can use this information to determine that the download is complete or that there is a problem connecting to the server." Hameline Decl., Exh. 13 at 24. Defendants describe the streaming of higher resolution data to the client as follows: "The Keyhole client seamlessly combines data with different resolutions to provide users the smooth experience of zooming in and out. However, you can only zoom into the level of detail allowed by the data. If you zoom closer than the base resolution, the viewer enlarges or resamples pixels, thus producing blurry pictures. Keyhole, Inc. provides high-resolution data (1 meter or better) for over 80 major metropolitan areas, 15-meter resolution data through out the United Sates, and 1-kilometer data for the entire world. Better resolution data, new cities, and more layers of information are constantly being added." Hameline Decl., Exh. 13 at 109.

15. Claim 1 of the '189 Patent also requires that the data blocks are provided to a "renderer" (or, as understood in the context of the '189 Patent, software, or a dedicated hardware processor along with a software package, running on a general purpose processor), which assists in the display of the terrain based on the provided data. The '189 Patent requires the renderer to receive one or more "coordinates in the terrain" along with an "indication of a respective resolution level." In the '189 Patent, "coordinates in the terrain" are any of a group of one or more numbers used to determine a position in the terrain. Examples of a "coordinate" given in the '189 Patent include x, y (longitude, latitude) and height, and/or resolution level. See, e.g., Hameline Decl., Exh. 7, col. 13, lns 11-17. Defendants' products include a renderer that renders according to their product descriptions. For example, "There are two ways to choose either OpenGL or DirectX as your 3D graphics rendering software. Select Set DirectX as the Default Render." Hameline Decl., Exh. 13 at 114. Also, as I understand, even if Defendants' definition of a renderer is used, the accused products do have a renderer that receives data blocks and generates images as proposed in Defendants' definition of renderer. Hameline Decl., Exh. 10; Exh. 15 at 14.

16. The Google Earth products similarly allow a user to determine a position in the terrain that is desired for viewing by entering "coordinates in the terrain." The Google Earth products allow the user to enter coordinates, such as an address, an intersection, a local point of interest, or latitude/longitude coordinates. I understand that Defendants define the phrase "coordinates in the terrain" as "a pair of numerical coordinates, such as latitude and longitude or x and y coordinates, of a particular location in the terrain." Hameline Decl., Exh. 15 at 21. The '189 Patent suggests that the user can

enter more than a "pair" (or two) coordinates, but even assuming this term were so limited, Google Earth would still include this element of the claims of the '189 Patent, as the accused products allow for the entry of a pair of longitude/latitude coordinates, such as latitude and longitude or x and y coordinates, to determine a particular location in the terrain. Hameline Decl., Exhs. 10, 13.

17. As mentioned above, the '189 Patent also requires the renderer to receive not only one or more "coordinates in the terrain," but also an "indication of a respective resolution level." An "indication of a respective resolution level" means something that indicates, points out, or signifies a respective resolution level. In the Google Earth products, the user specifies the desired resolution of the terrain and the downloaded data corresponds to the specified coordinates and resolution. Hameline Decl., Exh. 10. The Google Earth data blocks of at least three different resolution levels are stored to allow a user to zoom in and out of a particular area. Hameline Decl., Exh. 13 at 109. "The Keyhole client seamlessly combines data with different resolutions to provide users the smooth experience of zooming in and out." Id. Certain of Google Earth's product literature also states that the "images show three different resolutions and the level of detail that you can reasonably expect from them." Hameline Decl., Exh. 13 at 109.

18. Claim 1 of the '189 Patent also requires a "first data block" and "data corresponding to the one or more coordinates." As discussed above, the Google Earth products provide more than one data block to the renderer in order to allow the user to view the requested terrain image. Therefore, a "first" data block that is received from a remote server is followed by a subsequent data block or blocks at a correspondingly higher resolution level higher than that present in the first block. The data contained in

the first and subsequent data blocks correspond to the one or more coordinates if the provided block from the local memory is not at the indicated resolution level.

19. As described in the Skyline invention, the Google Earth products similarly download a first and then subsequent data blocks. These data blocks correspond to some coordinates to increase the resolution of an image if the first data block stored locally is not at the desired resolution. Hameline Decl., Exhs. 10, 21. To speed up the process of downloading the data blocks for the user, Google Earth may provide a first resolution data block from local memory and then supplements that first data block with data blocks at a higher resolution retrieved from a server. The user is able to observe this process when using the Google Earth product, as described above in Paragraph 13. I understand that Defendants have argued that the definition of the phrase "data corresponding to the one or more coordinates" should be "data representing the terrain and any additional optional data objects to be overlaid on the terrain that is found at the coordinates received from the renderer." Hameline Decl., Exh. 15 at 26. Even assuming this definition is correct, the Google Earth products meet this definition. For example, Google's web site states that "With Google Earth, in 38 US cities, you can see buildings in 3D from 'ground up.' You can activate the 'buildings' layers on the bottom navigation panel…Similarly, the terrain is also mapped in 3D, meaning you can see mountains and valleys and canyons in Google Earth." Hameline Decl., Exh. 21.

20. Claim 1 of the '189 Patent requires providing the renderer with a first data block that includes data corresponding to the one or more coordinates from a "local memory." "Local memory" is a memory of a local computer. As discussed above, Google Earth products enable the user to zoom in or out of an image, depending on the

desired level of detail. The downloaded image data corresponds to the coordinates in the terrain requested by the user and is stored in a local memory. This storage of terrain data in the local memory allows the client to access the desired terrain data without having to access the network each time terrain data is subsequently requested. As described in the product literature: "This feature determines how much uncompressed data is stored in the computer's main memory (RAM) so that the Keyhole software doesn't have to retrieve the images from the hard drive. By using stored, or cached data, the viewer can display previously viewed images much faster." Hameline Decl., Exh. 13 at 117. Defendants' product literature further explains: "In a manner similar to memory cache, the disk cache feature determines how much compressed data is stored on the local hard drive so that the Keyhole software doesn't have to go to the network to get the image. The end result is that the images will load more quickly. However, this feature only works well if you are viewing areas that you have previously viewed. After you cache is full, older data is pushed out to accommodate newer data." Id. at 118. The local hard drive, main memory, and memory cache, as used by Defendants, are all examples of "local memory".

21. Claim 1 of the '189 Patent also requires a "remote server" and a "communication link," both of which are found in the Google Earth products. A client machine running Google Earth is connected to a server by communication links and networks, such as the Internet and associated software and hardware, to download programs and data from remote servers operated for or by the Defendants. The remote servers provide additional streamed data and information to the client over the communication links and networks. The data and information includes additional data

blocks describing the terrain, at higher resolution levels, if these higher resolution data blocks are not already stored in the local memory of the client computer. The Google Earth products stream data at higher resolution levels to the client from a remote server. As described in the product literature: "Slower connections take longer to sharpen up the image to its highest resolution." Hameline Decl., Exhs. 10 & 13 at 110. Moreover, Defendants describe that the "Keyhole tab displays the World Places and High Res Places folders that are automatically streamed when you connect to a Keyhole Server." Hameline Decl., Exh. 13 at 69. Therefore, the Google Earth products use both remote servers and communication links to stream higher resolution data to the client, as required by Claim 1 of the '189 Patent.

22. Like Claim 1, Claim 12 includes "data blocks describing three-dimensional terrain," "render," "hierarchical structure" and "plurality of different resolution levels." The Google Earth products include software that is stored in a storage media that can be read by a computer and run on compatible computers, or that read and execute the instructions in the software. As described above, the Google Earth apparatus provides data blocks describes 3D terrain to a renderer. These data blocks belong to a hierarchical structure, which includes data blocks at many different resolution levels. As explained in the product literature: "You can also interact directly with the overview map to influence the display of the Keyhole client 3D viewer itself. Click on any position on the map and both the overview display and the Keyhole client 3D viewer will adjust position to the point in the overview map that you click on. For example, if the current view is located in the United States, you can click on the African continent and both the

overview indicator and the 3D viewer will move to the new position." Hameline Decl., Exh. 13 at 79-80.

23. As explained earlier, the Google Earth products include a local memory which stores data. As claimed in the '189 Patent, the data includes data blocks corresponding to coordinates proximal to a current viewpoint (from the perspective of a user of the accused software) of the renderer. In the product literature describes that the Google Earth products utilize a local memory to store data blocks of higher resolution: "The Cache tab in the Preferences panel provides options that you can use to modify the memory requirement settings for your Keyhole client. This section covers those features." Hameline Decl., Exh. 13 at 117, 118.

24. Claim 12 of the '189 Patent also requires a "communication link" and a "remote server." The Google Earth products include a communication link or, as used in the '189 Patent, a connection used for transferring data between computers. Hameline Decl., Exh. 7, Fig. 5. The Google Earth apparatus streams the first and subsequent higher resolution data block to the client over a network, such as the Internet. The data blocks in the Google Earth products are received from a remote server via the communication link. A "Streaming Status Bar" found in the Google Earth software indicates the status of information being actively retrieved from the remote server database to the user. For example, as explained in the product literature: "Creating a Network Link: To view a KML file on the network without manually copying it over to your local computer, you can create a network link to reference the file." Hameline Decl., Exh. 13 at 64. The product literature further states that: "Slower connections take longer to sharpen up the image to its highest resolution." Id. at 110. These documents confirm that the Google

Earth products include a communication link, through which the memory receives the data blocks from a remote server. "The Keyhole client seamlessly combines data with different resolutions to provide users the smooth experience of zooming in and out." Id. at 109.

25. Claim 12 further requires a "processor," "resolution level" "renderer," and a "first data block". The Google Earth products include a "processor," which in the context of the '189 Patent means hardware and/or software that processes computer-readable instructions. Hameline Decl., Exh. 7 at Fig. 5 (processor 20), col. 10 lns. 61-67, col. 11, lns. 39-44. I understand that the Defendants have taken the position that a "processor" is merely "a general purpose processor of the local computer as distinguished from the dedicated hardware processor that runs the 'renderer'." I believe that the Google Earth products contain a "processor" under either definition. The Google Earth products require a processor to process the instructions and operate in conjunction with the other elements to provide the functionality touted for Google Earth. For example, in their product literature, Defendants set forth the hardware requirements for a system running their software, including "CPU (central processor) Speed Intel® Pentium® PIII 500 MHz *or* AMD equivalent." Hameline Decl., Exh. 13 at 109. Other processors are also used in the Google Earth products, for example "New graphics cards with 32 MB of memory, which deliver stunning performance with the Keyhole client, are available for less than $100. See '"3D Rendering Software"' on page 114 of Keyhole Performance for a list of recommended graphics cards." Id.; Hameline Decl., Exh. 13.

26. I understand that Google Earth's processor receives the specified coordinates along with indication of a respective resolution level. According to the

product literature, the Google Earth product "seamlessly combines data with different resolutions to provide users the smooth experience of zooming in and out." Hameline Decl., Exh. 13 at 109.

27. Given my review of the publicly available documentation about the Google Earth products, my reading of the '189 Patent, as well as my decades of experience in the Earth imaging and mapping field, I believe that each and every element of Claims 1 and 12 of the '189 Patent is included in or practiced by the Google Earth products.

Signed under the penalties of perjury this 4th day of January, 2006.

/s/ Terry Keating

Terry Keating, Ph.D.

Attachments

Certificate of Service

I hereby certify that on January 4, 2006, I caused a true and accurate copy of the foregoing document to be served upon all counsel of record for each party, by complying with this Court's Administrative Procedures for Electronic Case Filing.

/s/ H. Joseph Hameline
H. Joseph Hameline, BBO # 218710

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